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WITNESS my hand this
Twenty-seventh day of June 2003

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AUSTRALIA

PATENTS ACT 1990

PROVISIONAL SPECIFICATION

FOR THE INVENTION ENTITLED:-

"METHOD AND APPARATUS FOR RECOVERING TONER FROM TONER CARTRIDGES"

The invention is described in the following statement:-

Technical Field

The present invention relates generally to recycling of toner cartridges, and more particularly to the separation of materials during the recycling of toner cartridges.

Description of the Prior Art

The invention has been developed primarily for use in recovering toner powder from toner cartridges, and will be described predominantly with reference to this application. It will be appreciated, however, that the invention is not limited to this particular field of use, being also applicable to other applications where separating a powder material from large pieces is required.

Toner printing technology has been almost universally adapted in photocopiers and computer printers. These devices commonly have an internal reservoir for storing toner powder which is used in the printing process. Initially, these reservoirs were fixed to the machine and required manual refilling by pouring toner from a refill packet. Nowadays, in an attempt to limit direct contact with the messy toner powder, replaceable toner cartridges have largely superseded refillable reservoirs. Cartridges are filled in a factory where the distribution of toner powder can be strictly controlled to minimise and isolate spillage.

The popularity of disposable cartridges has meant the number of cartridges discarded has increased exponentially in recent years. Used cartridges may, in some cases, be recycled and recharged a number of times by a specialist reconditioner. Eventually however, all cartridges are either stripped down for their materials or more often, thrown out altogether. Either of these alternatives presents their own particular problems.

The cartridges are generally a combination of thermo-plastic resins and ferrous and non-ferrous metals. These materials are slow to break down naturally and thus present a significant environmental pollutant. In addition, it is rare that toner cartridges are entirely empty when they are replaced. Often 5% to 10% of the toner capacity of the cartridge remains when discarded. This figure can be as high as 100% if the cartridge is faulty, has been superseded or past its use by date. The residual toner also presents a significant environmental hazard when the cartridges are thrown out. However, whilst toner along with the materials which make up the cartridges are recyclable, the nature of toner powder makes stripping the cartridges difficult.

Toner is a very fine powder and will readily become airborne and circulate with airflow. As such it can be easily inhaled and may be a significant health issue with workers. Moreover, as with many fine powders, when airborne, in the right concentration and conditions it can ignite and explode.

Currently the stripping and materials separation of cartridges is carried out manually. This not only places those doing the stripping in a high risk environment, it is also labour intensive and expensive. In modernised countries, which are the greatest users of these printer cartridges, labour cost are high meaning the manual dismantling of cartridges is not cost effective.

It is an object of the present invention to overcome or ameliorate one or more of these disadvantages of prior art, or at least to provide a useful alternative.

Brief Summary of the Invention

In a first aspect, the invention provides an apparatus for recovering toner from toner cartridges including:

a shredder to break up toner cartridges into pieces and release any toner

within the cartridges;

a sifting barrier for sifting the cartridge pieces so that only particles under a predetermined size pass through the barrier;

agitation means to agitate the pieces and mobilise the toner; and

an vacuum extractor for extracting air from around the sifting barrier to remove airborne particles.

Preferably, the invention includes a mechanical separator having a sifting barrier in the form of a vibrating screen.

Preferably, the mechanical separator includes a cover surrounding the vibrating screen.

Preferably the mechanical separator includes an air duct in fluid communication with the vacuum extractor.

Preferably, the invention includes a trommel drum separator.

Preferably the trommel includes an air duct in fluid communication with the vacuum extractor.

According to a second aspect, the invention provides a method of recovering toner from toner cartridges, said method including the steps of:

breaking up toner cartridges into pieces to release any toner within the cartridges;

passing the cartridge pieces over a sifting barrier so that only particles under a predetermined size pass through the barrier;

agitating the pieces to mobilise the toner; and

extracting air from adjacent the pieces to remove airborne particles.

Brief Description of the Drawings

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a front view of an apparatus for recovering toner from toner cartridges in accordance with the invention;

Fig. 2 is side view of the apparatus shown in Fig. 1;

Fig. 3 is a top view of the apparatus shown in Fig. 1; and

Fig. 4 is an enlarged front view of the apparatus shown in Fig. 1.

Detailed Description of the Invention

Referring to the drawings, in general terms the invention provides an apparatus for the recovery of toner from toner cartridges. The apparatus includes a shredder 1 for breaking the toner cartridges into pieces, thereby releasing any toner from within the otherwise substantially sealed cartridges.

The toner pieces along with any free toner powder are then fed through a separation stage generally shown as 2 in the figures. The separation stage includes a mechanical separator 3 and a trommel separator 4. Each separator employs a sifting screen, numbered 5 and 6 respectively, which allow smaller particles to fall though the screen while holding back the larger pieces. Both separators agitate the pieces to mobilise the smaller particles.

A vacuum extraction system 7 is used to withdraw air from around the cartridge pieces. This not only has the effect of encouraging the small particles through the screen, but also extracts airborne toner dust and limits the amount of dust that exits the system to the surrounding air.

To describe the process in greater detail, toner cartridges are collected and transported to the plant for recycling. Before the cartridges are processed, they may be examined to determine statistical information on the origin, number and types of cartridges as well as a checking to ensure that each cartridge is suitable for processing. The examination maybe conducted by a manual check of each cartridge or by automatic means. Automatic examination means may include a bar code and bar-code reader system, electronic data chip and reader or knowledge/image database recognition.

Referring to Figure 1, the cartridges are then placed in a hopper 8 which feeds a conveyor belt 9. The conveyor 9 transports the whole cartridges to shredder hopper 10 situated above the shredder 1. Referring now to Figure 4, the shredder employs twin rollers 11 with intermeshing projections to grind the cartridges into pieces not exceeding 25 millimetres in width. The shredding process releases much of the toner from the cartridges however, some toner will adhere to the larger pieces of cartridge due to static charge or mechanical binding.

The toner and pieces of cartridge then drop through the shredder chute 12 and into the mechanical separator 3. The mechanical separator includes a vibrating screen 5 surrounded by a cover 13 at the top that wraps around the lateral sides of the screen to the bottom. A tray 14 is disposed within the cover, underneath the screen. The screen is powered by an electric motor 15, which cycles the screen at around 50Hz. The entire separator 3 is not in direct contact with the rest of the apparatus and is located on springs 16 to isolate its movement.

The screen 5 is sloped downwardly at an angle between 5° and 20°, but preferably 10°. This slope combined with the vibration, encourages the cartridge pieces to move gradually over the screen 5 and through the separator 3 toward the separator exit 17. If the angle too small, the pieces will remain in the separator too long and slow

the process unnecessarily, if the angle is too steep they will pass through too quickly and are not subjected to sufficient vibration. The high frequency vibration has the effect of mobilising the toner powder, detaching it from the larger plastic pieces. This allows the powder and other small particles to drop through the screen 5 and into the tray 14 at the bottom of the separator 3. They tray is sloped at an angle similar to the screen such that the particles are channelled down the tray and into the duct 18.

As shown in Figure 3, the duct 18 is in turn, connected by ducting 19 to the vacuum extraction system 7, which withdraws air from the tray 14 of the separator 3. The passage of air transports the small particles through the ducting 19 and into the toner collector 20. In addition, a low static pressure is formed within the separator 3 by the vacating air. This low pressure creates a continuous airflow into the separator from outside which reduces the amount of powder and dust escaping from the separator and into the surrounding air. Moreover, toner powder and small particles are carried by the airflow through the screen 5, into the tray 14 and duct 18.

The toner collector 20 may be a standard or modified dust extraction unit where the small particles can be filtered from the air and stored. Later, the particles are transported to a storage tank 21. Further processing of these particles to purify the toner dust may be necessary at a later stage.

Any pieces, which do not fall through the screen, are passed from the mechanical separator exit 17 into the trommel 4. As is known in the art, the trommel includes an axially rotating inner drum 22 and a surrounding outer cover 23. The inner drum is orientated so that its bottom side is sloped slightly downwardly, approximately 10 degrees off horizontal. This slope and the rotation advance the cartridges pieces through the drum 22 toward the trommel exit 24. The drum rotates so that the pieces are raised up the side of the drum 22 before falling back to the bottom. This tumbling action may

be enhanced by small protrusions and longitudinal ribs on the inside surface of the drum which catch and raise the pieces. The agitation acts to mobilise any small particles.

The drum 22 also acts as a separation screen; it is perforated to allow the smaller particles to pass through the perforations and into the space between it and the cover 23. At the bottom of the cover, an air duct 25 is connected to the extraction system 7 by ducting 26 to withdraw the particles along with air from within the cover. As before, this has the effect of encouraging small particles to pass from the inner drum 22 into the cover as well as reducing the likelihood that airborne particles will escape from the trommel.

The small particles collected from the trommel 4 are filtered in the toner collector 20 and stored.

The remaining larger cartridge pieces, now substantially excluding toner dust and small particles exit the trommel 4 onto a second conveyor 27. At the end of the conveyor 27 a magnetic head pulley 28 and twin chute assembly 29 substantially separates the ferrous metal components from the other components into bins, 30 and 31 respectively.

Additional air ducts can be added to extract air from the system or its surroundings at any point where particle concentration may be high. In this way, the air surrounding the invention remains substantially free of particles, or at least in concentrations which are not hazardous to workers and do not present a risk of explosion.

In alternative embodiments, ionised or compressed air is injected into the separators or shredder chute. The compressed air is directed to blow the powder from the larger pieces. The air may be ionised to overcome any static charge attraction between the toner dust and the cartridge pieces.

It will be appreciated that the invention provides a largely automated method and apparatus for recovering toner powder from toner cartridges. The invention enables the materials of cartridges to be recycled quickly, in a cost effective manner. Moreover, particulate concentration in the surrounding air is vastly reduced, eliminating the potential hazards of dust inhalation by workers and the risk of explosion. In all these respects, the invention represents practical and commercially significant improvement over the prior art.

Although the invention has been described with reference to specific examples it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of recovering toner from toner cartridges, said method including the steps of:

breaking up toner cartridges into pieces to release any toner within the cartridges;

passing the cartridge pieces over a sifting barrier so that only particles under a predetermined size pass through the barrier;

agitating the pieces to mobilise the toner; and

extracting air from adjacent the pieces to remove airborne particles.

2. An apparatus of recovering toner from toner cartridges including:

a shredder to break up toner cartridges into pieces and release any toner within the cartridges;

a sifting barrier for sifting the cartridge pieces so that only particles under a predetermined size pass through the barrier;

agitation means to agitate the pieces and mobilise the toner; and

an extractor for extracting air from around the sifting barrier to remove airborne particles.

DATED This 13th Day of June, 2002

CLOSE THE LOOP TECHNOLOGIES PTY LTD

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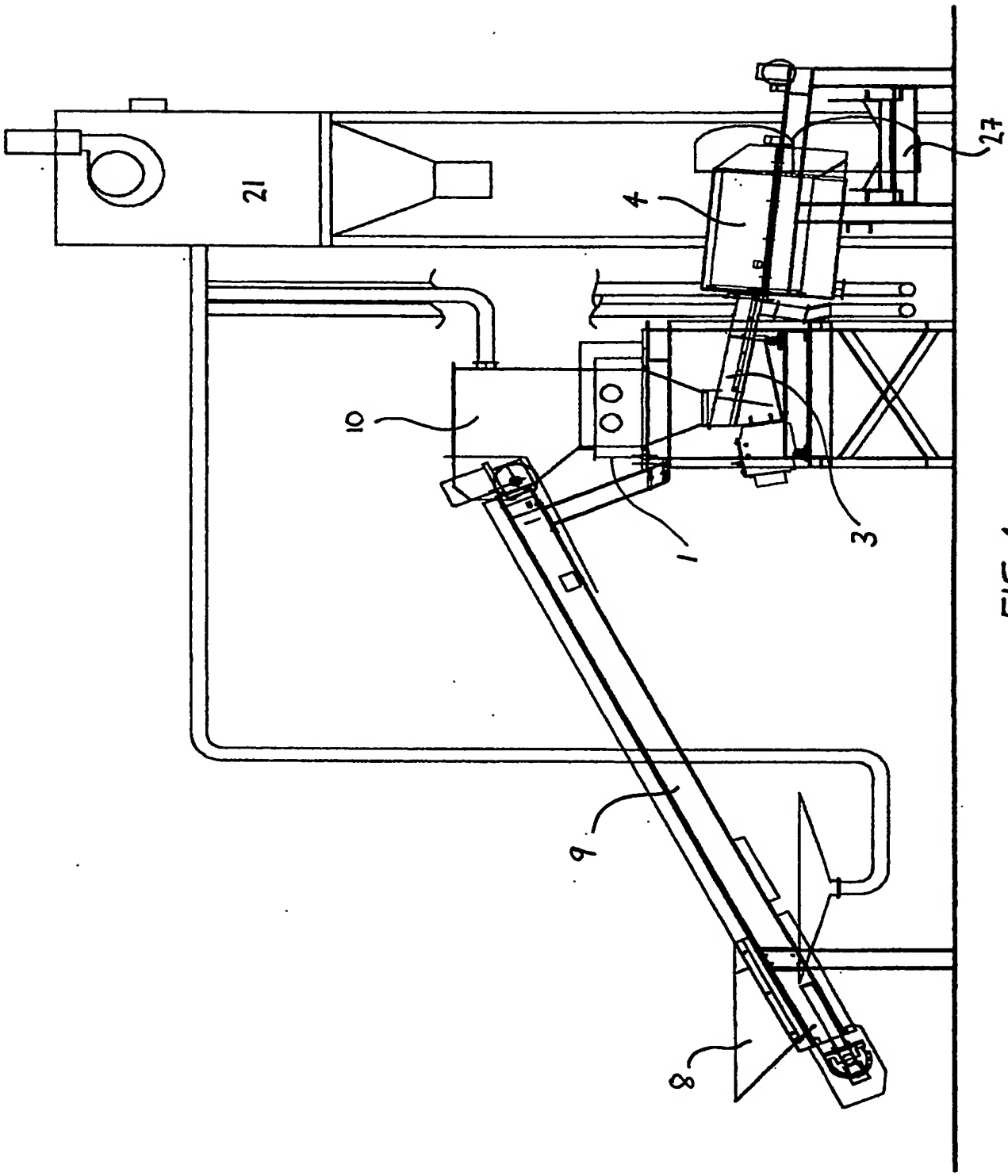

FIG. 1

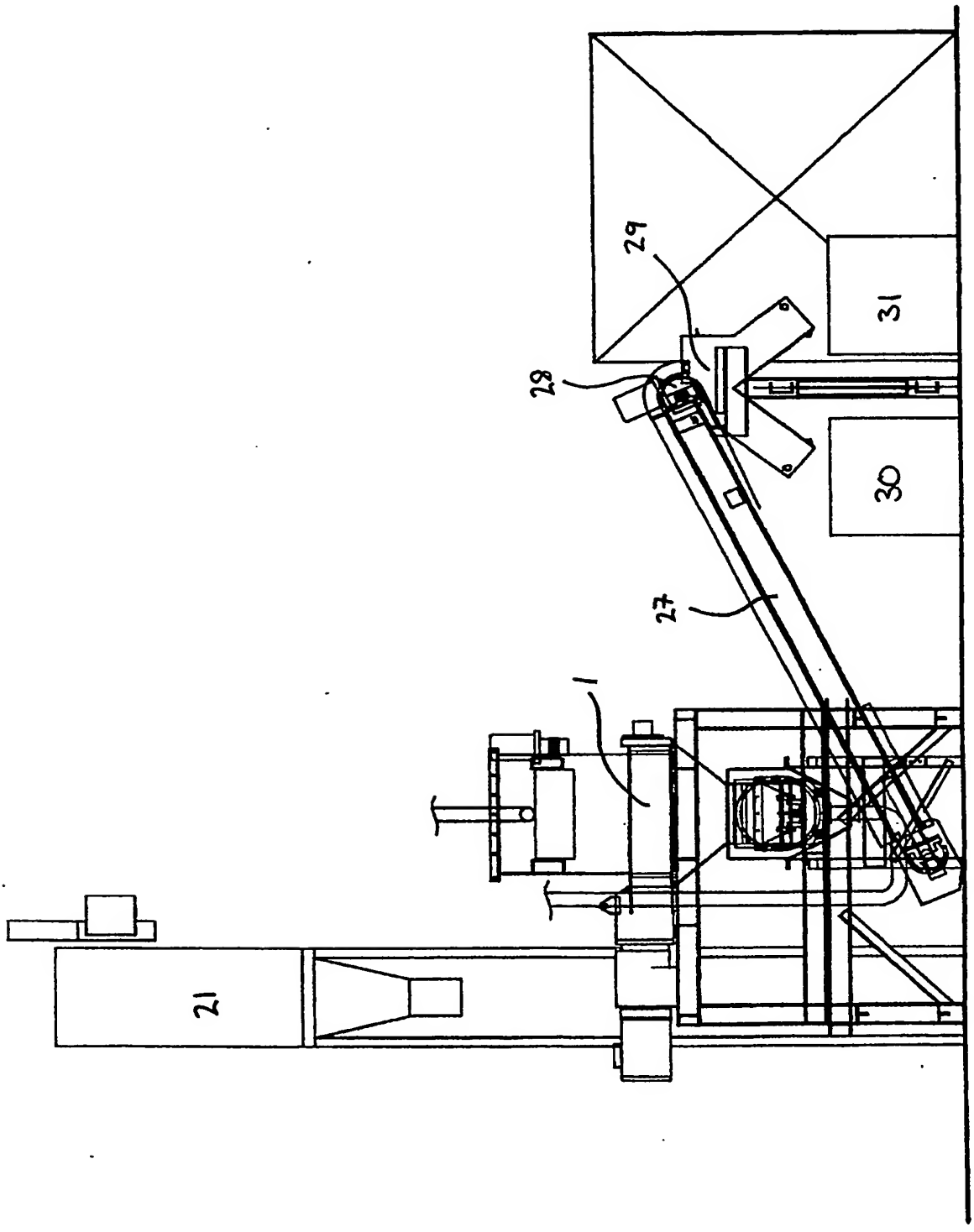

FIG.2

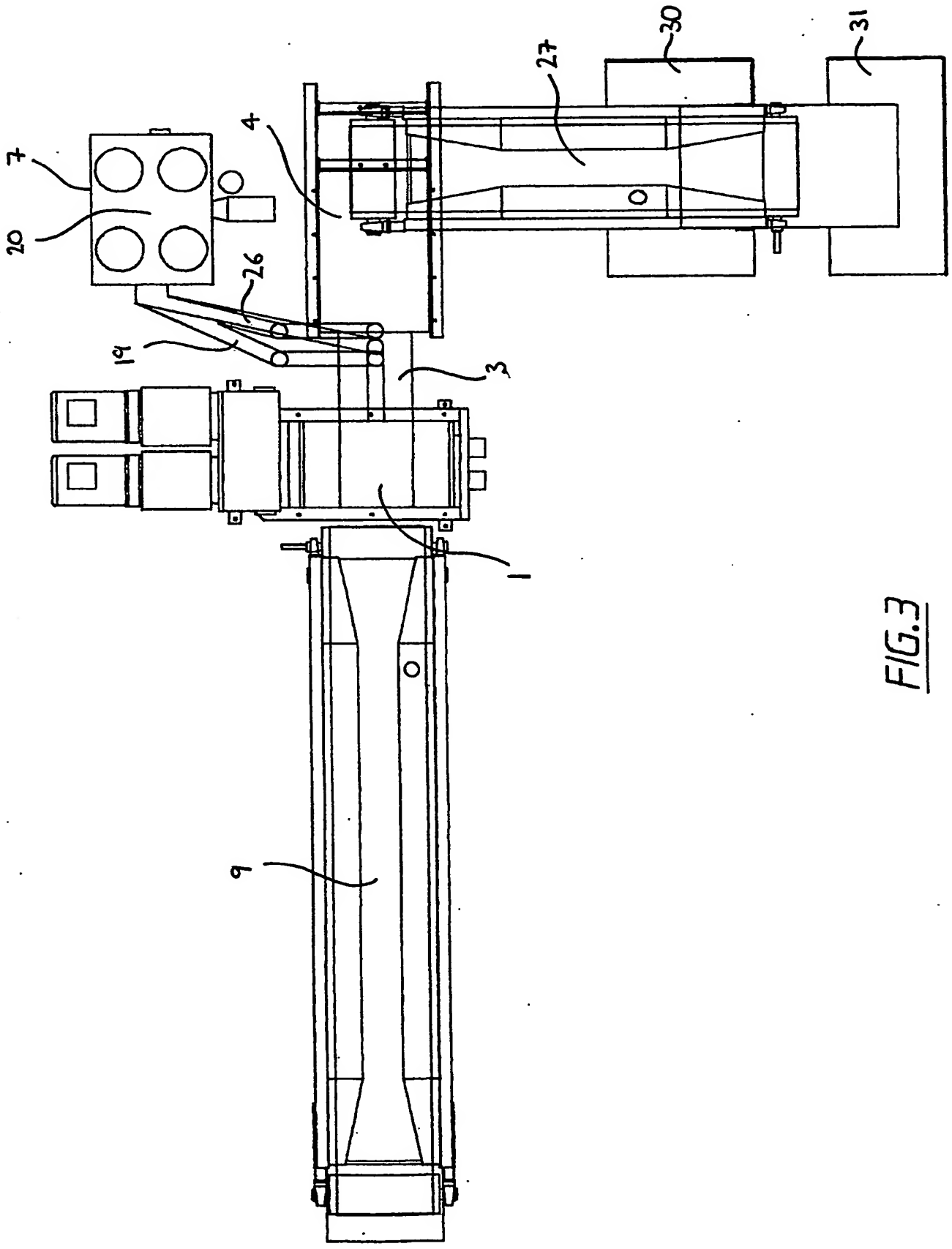

FIG.3

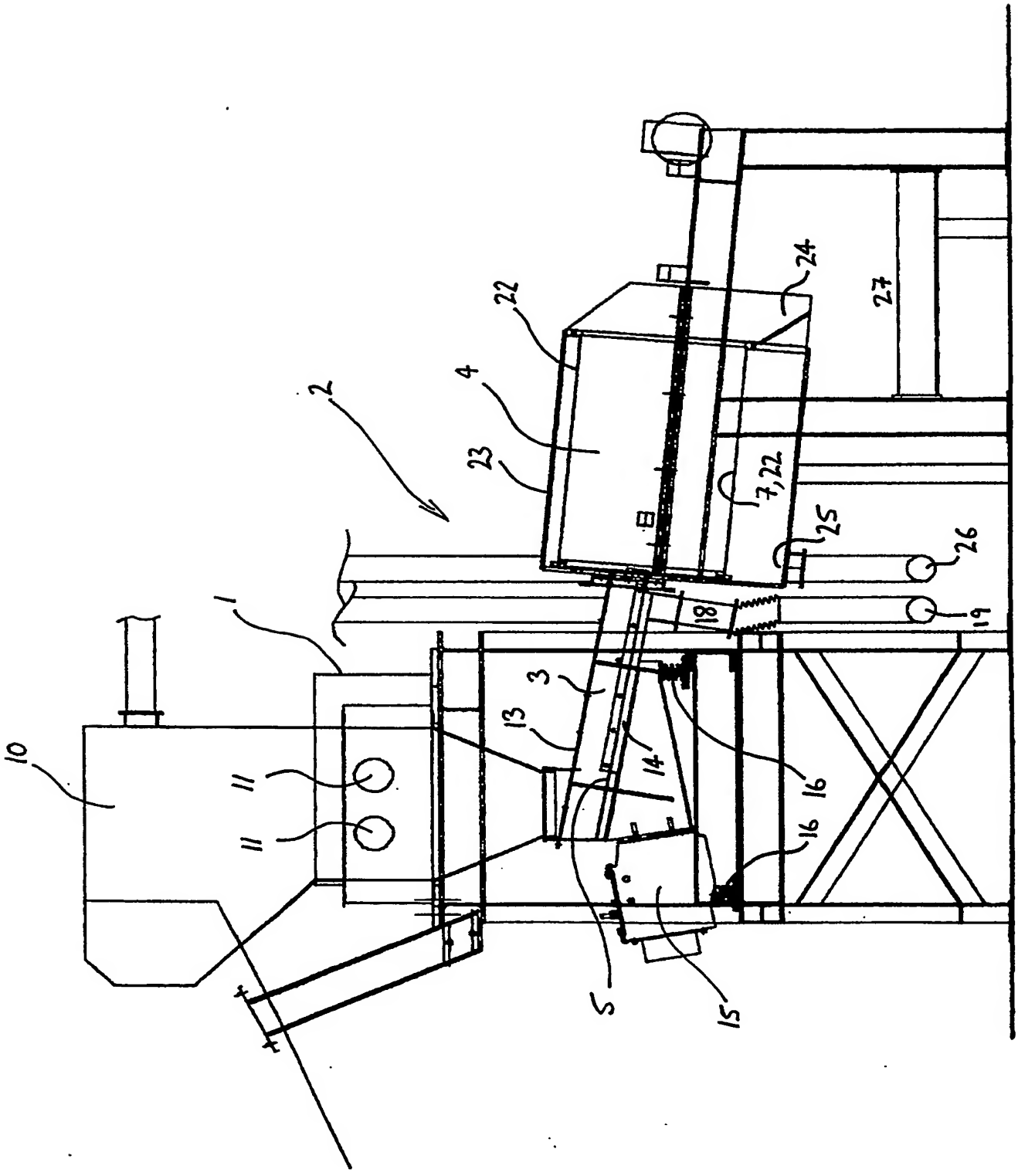

FIG.4